RUGGEDCOM®
INDUSTRIAL STRENGTH NETWORKS™

RuggedSwitch™ RS900 Family

Hardware Installation Guide

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www.RuggedCom.com

RuggedSwitch™ RS900 Family: Hardware Installation Guide

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FCC Statement And Cautions

Federal Communications Commission Radio Frequency Interference Statement

This equipment has been tested and found to comply with the limits for a Class A digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Caution: LASER

This product contains a laser system and is classified as a CLASS 1 LASER PRODUCT. Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Caution: Service

This product contains no user-serviceable parts. Attempted service by unauthorized personnel shall render all warranties null and void.

Changes or modifications not expressly approved by RuggedCom Inc. could invalidate specifications, test results, and agency approvals, and void the user's authority to operate the equipment.

Should this device require service, refer to Appendix A, Warranty in this guide.

Caution: Physical Access

This product should be installed in a restricted access location where access can only be gained by service personnel or users who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and access is through the use of a tool or lock and key, or other means of security, and is controlled by the authority responsible for the location.

1. Product Overview

1.1. Functional Overview

The RuggedSwitch® RS900 family of Ethernet switches are environmentally hardened, fully managed switches supporting a variety of Ethernet interfaces including copper, fiber, wireless as well as Serial communications. The RS900 family's superior ruggedized design coupled with the RuggedSwitch Operating System (ROS™) provides improved system reliability and advanced networking features making it ideally suited for creating Ethernet networks for mission-critical, real-time, control applications.

RS900 Family Common Product Features

- Operating temperature: -40° to 85°C (no fans)
- Fully integrated power supply
- Power supply options: 12, 24, 48 or 60 VDC, and Universal HI (88-300VDC or 84-264VAC)
- Failsafe output relay for critical failure or error alarming
- Industry standard fiber optical connectors: LC, SC, ST, MTRJ
- Multimode and Singlemode optical transceivers
- Long haul optics allow distances up to 90 km
- Advanced layer-2 switching functions including Flow-Control, Link Aggregation, MAC Bridges, Rapid Spanning Tree, Message Prioritization, VLANs and Port Based Network Access Control

1.2. RuggedSwitch®

1.2.1. RS900

9 Port Fiber Optic Ethernet Switch

- Up to 9 fast Ethernet ports
- Copper and fiber options

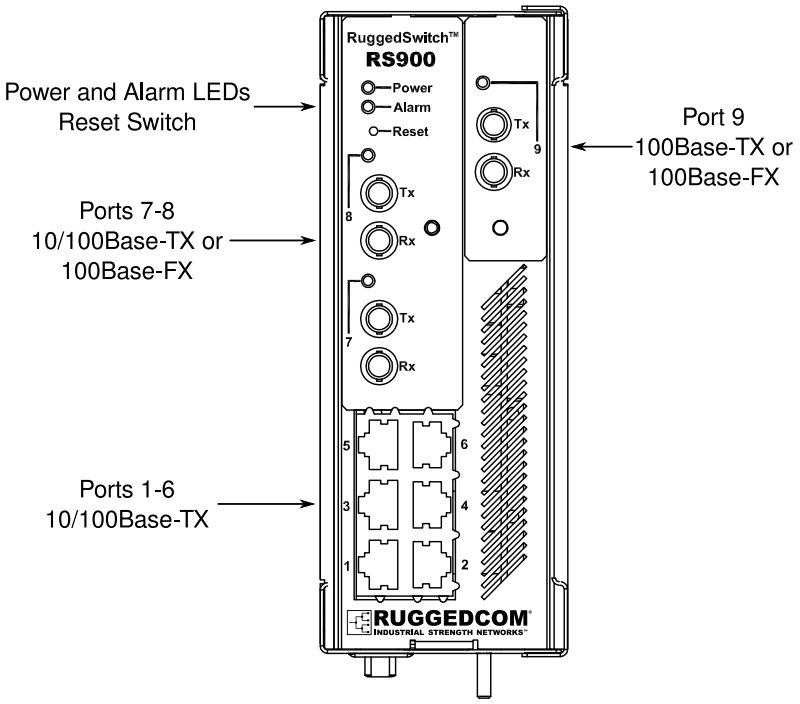

Figure 1.1. RS900 Front Panel

1.3. RuggedWireless™ Family of Products

Wireless Port Characteristics

- Configurable as an access, client, or bridge device
- IEEE 802.11b/g Wireless Access Point with data rates up to 54 Mbps
- WPA (Wi-Fi Protected Access) with TKIP for enhanced security and encryption
- WPA2 / 802.11i with CCMP for robust security and encryption
- IEEE 802.1X / RADIUS using EAP-PEAP for secure “enterprise class” authentication configuration
- Pre-shared Key Mode (PSK) for “personal” mode authentication configuration

1.3.1. RS900W

9 Port Ethernet Switch with Wireless Interface

- 1 Wireless interface
- Up to 8 fast Ethernet ports
- Copper and fiber options

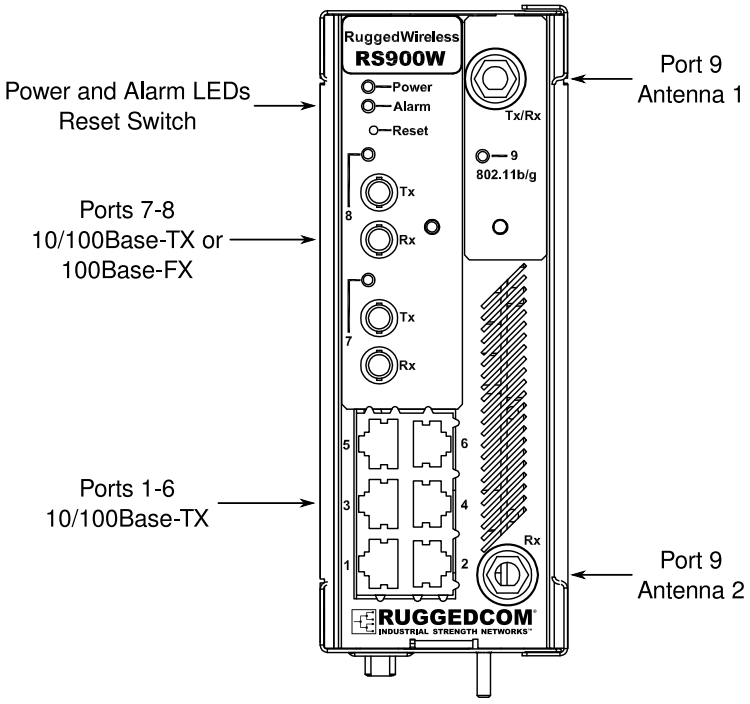

Figure 1.2. RS900W Front Panel

1.3.2. RS910W

Wireless Serial Device Server with 2 Serial and/or 2 Ethernet Ports

- 1 Wireless interface
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available
- 2 Optional Ethernet ports

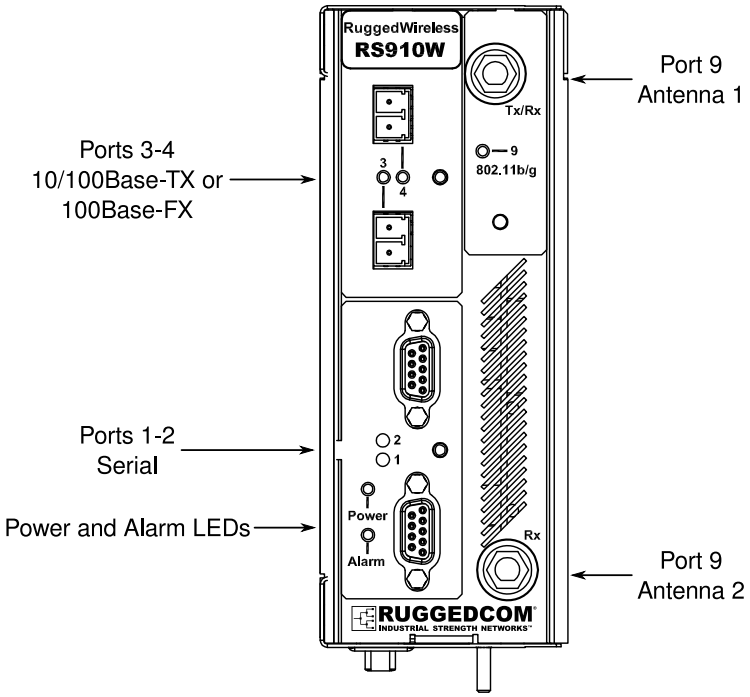

Figure 1.3. RS910W Front Panel

1.3.3. RS920W

Wireless Serial Device Server with 2 Serial Ports and 1 Ethernet over VDSL Interface

- 1 Wireless interface
- 1 EoVDSL interface
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available

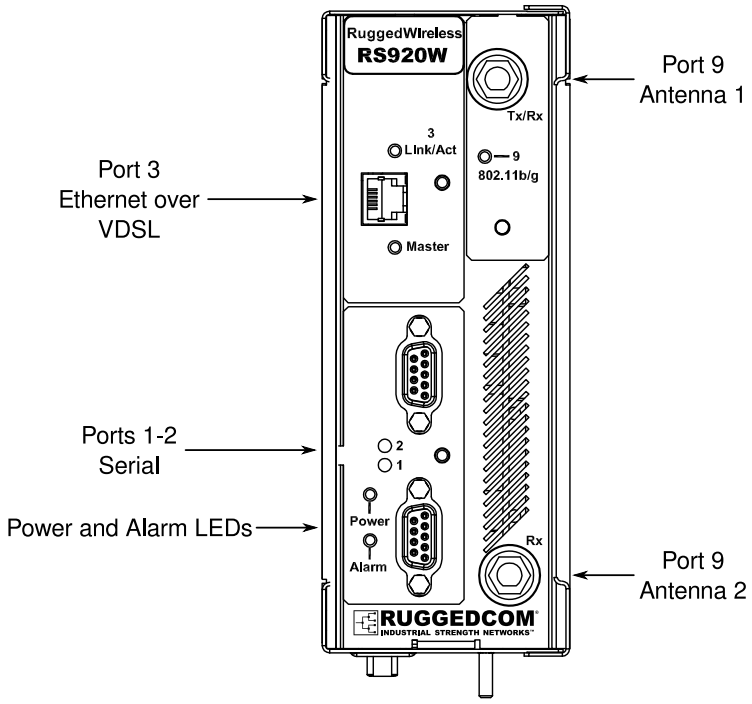

Figure 1.4. RS920W Front Panel

1.3.4. RS930W

Wireless Ethernet with Integrated 6-Port Switch and 1 Ethernet over VDSL Interface

- 1 Wireless interface
- 1 EoVDSL interface
- 6 fast Ethernet ports

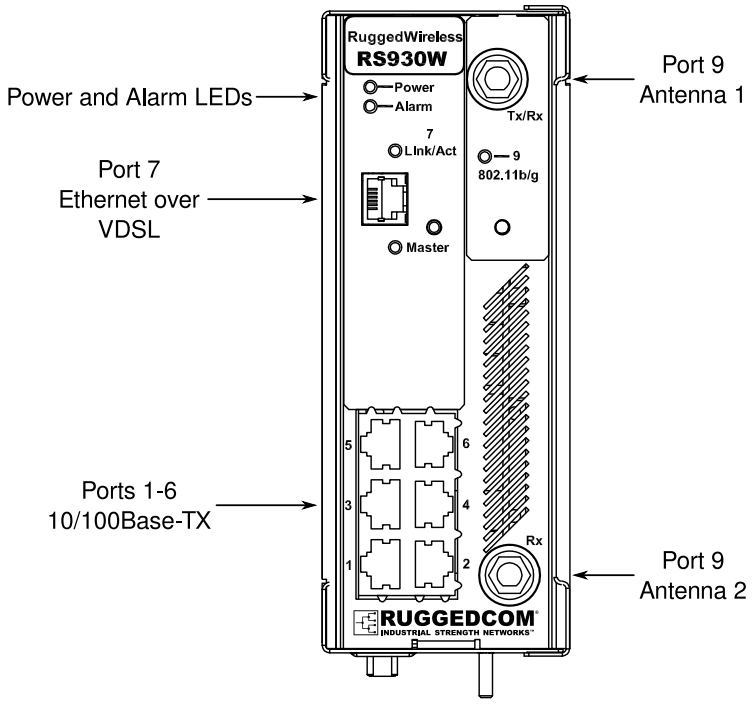

Figure 1.5. RS930W Front Panel

1.4. RuggedVDSL™ Family of Products

EoVDSL Port Characteristics

- Symmetric data rates up to 35 Mbps with distances up to 2.5 km
- Asymmetric data rates up to 40 Mbps with distances up to 5 km
- Automatically selects fastest data rate based on distance and quality of cable
- Manual speed configuration available

1.4.1. RS900L

Ethernet over VDSL with integrated 8-Port Switch

- 1 EoVDSL interface
- Up to 8 fast Ethernet ports
- Copper and fiber options

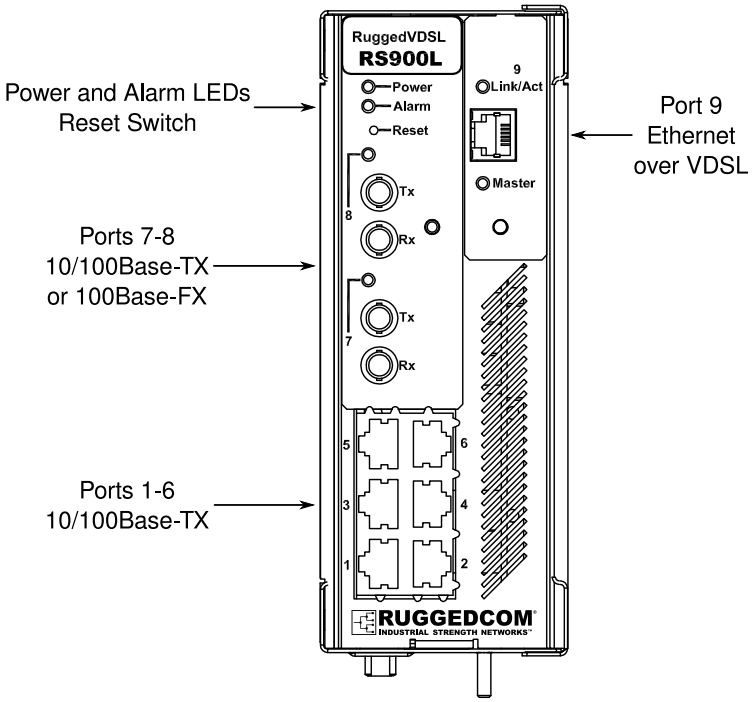

Figure 1.6. RS900L Front Panel

1.4.2. RS910L

Ethernet over VDSL with 2 Serial and/or 2 Ethernet Ports

- 1 EoVDSL interface
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available
- 2 Optional Ethernet ports

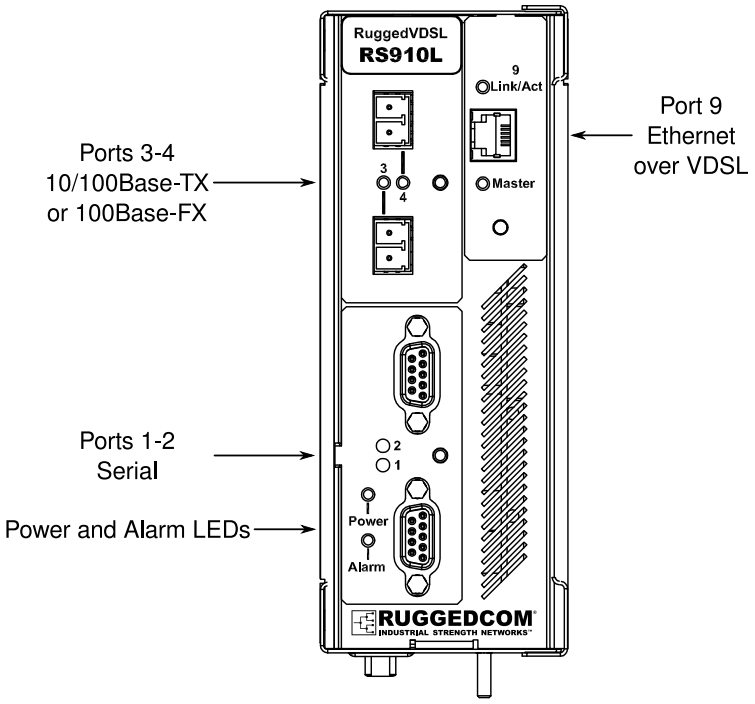

Figure 1.7. RS910L Front Panel

1.4.3. RS920L

Dual Ethernet over VDSL interfaces with integrated Dual Port Serial Server

- 2 EoVDSL interfaces
- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available

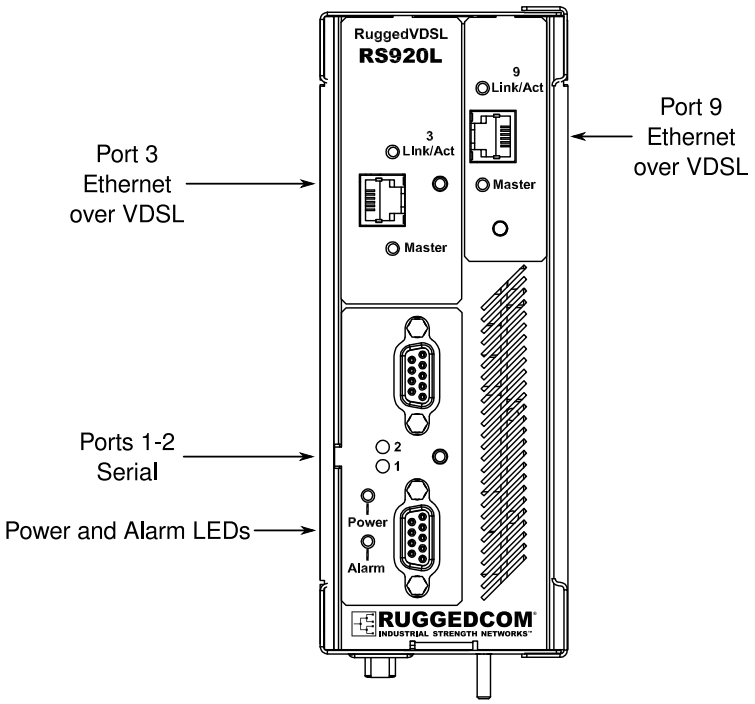

Figure 1.8. RS920L Front Panel

1.4.4. RS930L

Dual Ethernet over VDSL interfaces with Integrated 6-Port Switch

- 2 EoVDSL interfaces
- 6 fast Ethernet ports

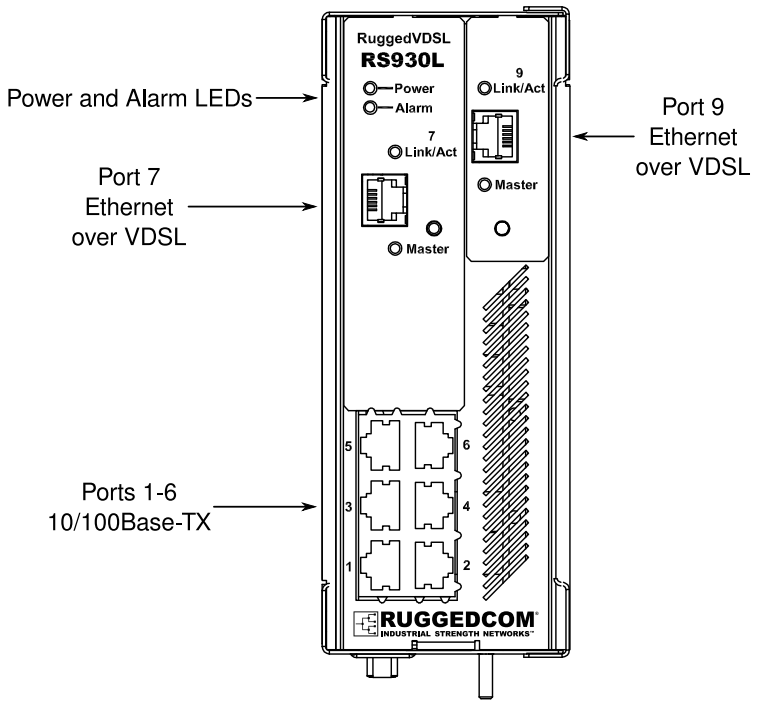

Figure 1.9. RS930L Front Panel

1.5. RuggedServer™

1.5.1. RS910

2-Port Serial Device Server with up to 3 Ethernet Ports

- 2 RS485/RS422/RS232 Serial ports (DB9 or RJ45); Serial Fiber interface (ST) available
- Up to 3 fast Ethernet ports
- Copper and fiber options

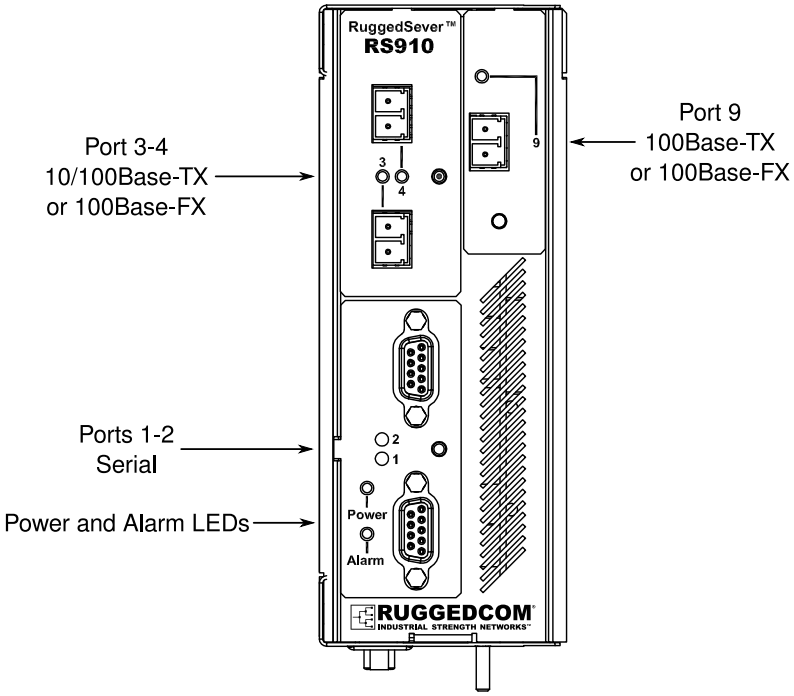

Figure 1.10. RS910 Front Panel

1.6. Front Panel Description

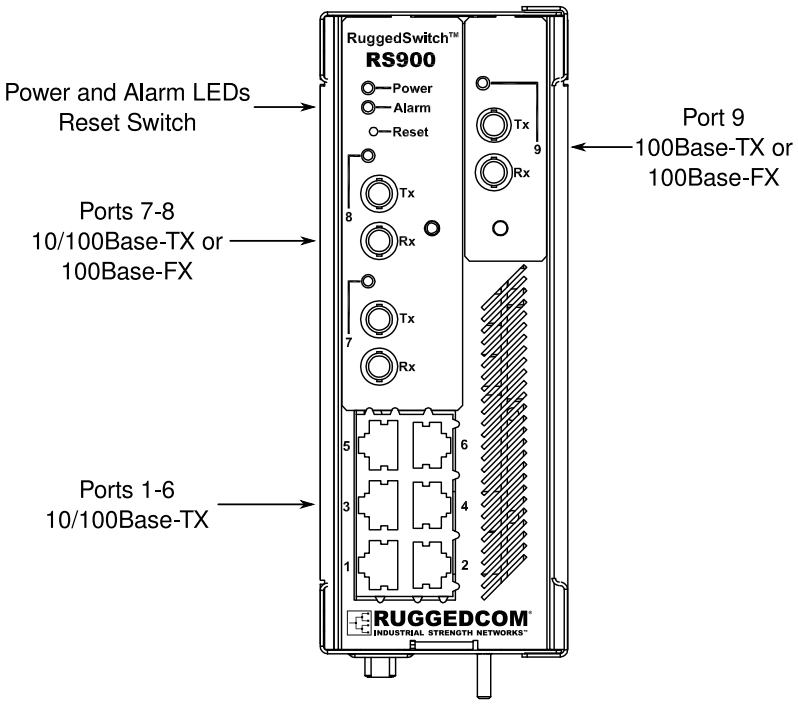

Figure 1.11. RS900 Front Panel Description

Status LED	Colour	Activity	Comments
Power LED	Green	Solid	Power On
Alarm LED	Red	Solid	Alarm condition exists

Table 1.1. Status LEDs

1.7. Bottom Panel Description

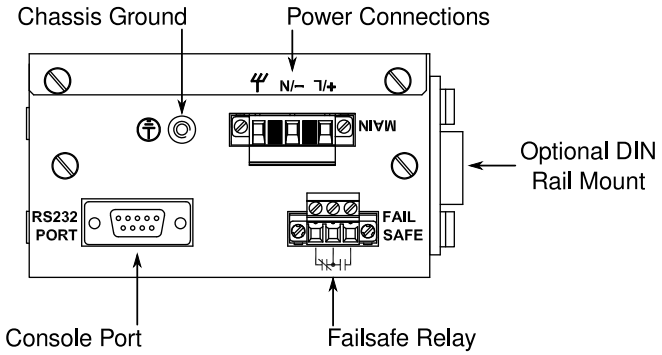

Figure 1.12. Bottom Panel Description

2. Installation

2.1. DIN Rail Mounting

An optional DIN rail-mounting bracket is available for the unit. The figure below details mounting instructions for the standard 1” DIN Rail.

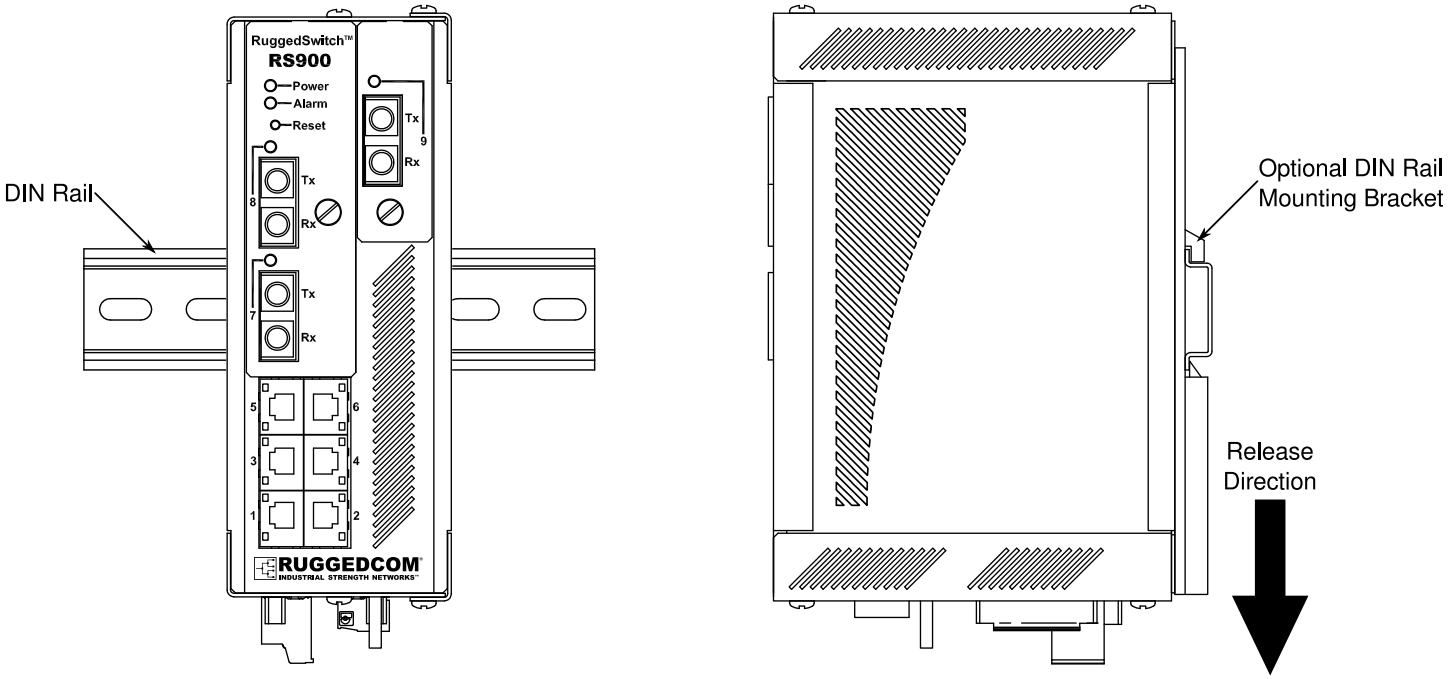

Figure 2.1. DIN Rail Mounting

2.2. Power Supply Wiring and Grounding

2.2.1. AC Power Supply Wiring and Grounding

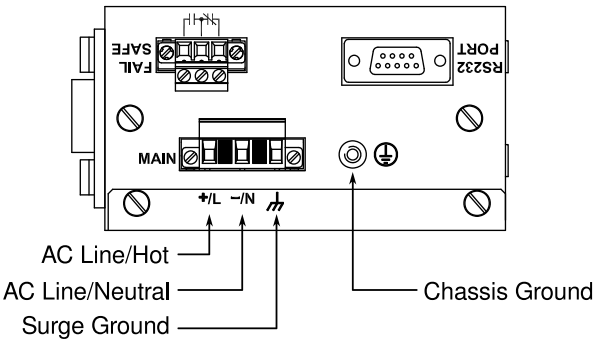

Figure 2.2. AC Power Supply Wiring and Grounding

The AC power supply inputs should be connected as follows:

1. **+/L** should be connected to AC Line/Hot.
2. **-/N** should be connected to AC Neutral.
3. **Surge Ground** should be connected to the Chassis Ground via a braided cable or other appropriate grounding wire. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
4. **Chassis Ground** must be connected to the AC ground terminal.

1. *Equipment must be installed according to the applicable country wiring codes.*
2. *All line-to-ground transient energy is shunted to the Surge Ground terminal. In cases where users require the inputs to be isolated from ground, remove the ground braid between Surge and Chassis Ground. Note that all line-to-ground transient protection circuitry will be disabled.*

2.2.2. DC Power Supply Wiring and Grounding

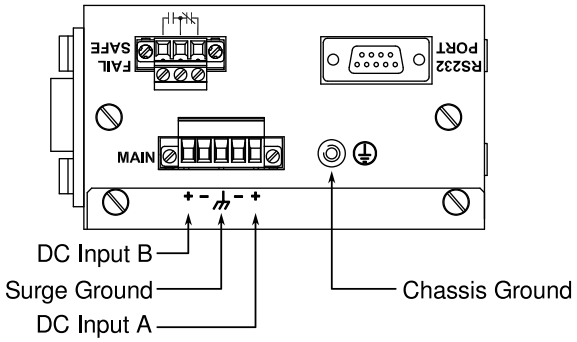

Figure 2.3. DC Power Supply Wiring and Grounding

The low voltage DC power supply features reverse polarity protection and dual independent inputs. The latter feature allows the connection of two DC sources with the same nominal voltage to provide redundant power supply inputs.

The DC power supply inputs should be connected as follows:

1. Connect to the DC inputs according to the polarity markings on the unit.
2. **Surge Ground** should be connected to the Chassis Ground via a braided cable or other appropriate grounding wire. Surge Ground is used as the ground conductor for all surge and transient suppression circuitry internal to the unit.
3. **Chassis Ground** must be connected to the protective earth.

1. *Equipment must be installed according to the applicable country wiring codes.*
2. *All line-to-ground transient energy is shunted to the Surge Ground terminal. In cases where users require the inputs to be isolated from ground, remove the ground braid between Surge and Chassis Ground. Note that all line-to-ground transient protection circuitry will be disabled.*

2.2.3. Failsafe Output Wiring

The Failsafe output relay is provided to signal critical error conditions that may occur on the unit. The contacts are energized upon power up of the unit and remain energized until an alarm condition or power loss occurs.

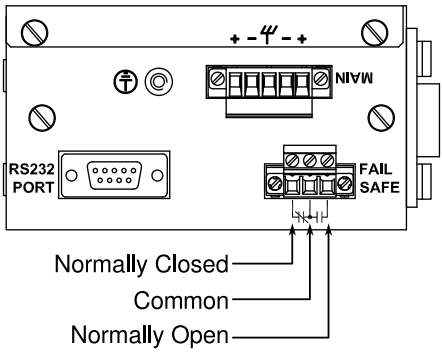

Figure 2.4. Failsafe Relay Output

2.2.4. Dielectric Strength Testing

Units which are to have dielectric strength testing (HIPOT testing) done in the field must have the braided ground cable disconnected during the test. This is required in order to prevent the surge suppression circuitry, which is connected to surge ground, from being activated.

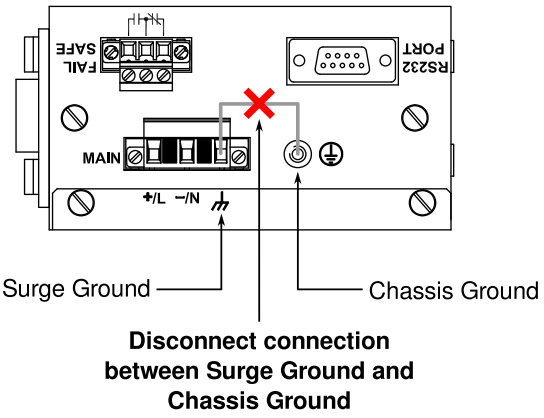

Figure 2.5. Dielectric Strength Testing

2.3. Console Port Wiring

The RS232 port is used for configuring the unit. A straight-through serial cable with a DB-9 connector is required. There is no need to crossover the Transmit and Receive signals from the PC side since this has been done internally.

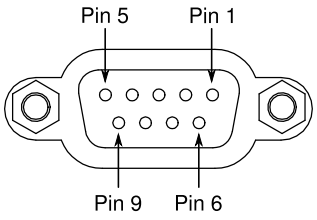

Figure 2.6. RS232 Female DCE Pinout

Pin	Signal
1	No Connection
2	Transmit Data
3	Receive Data
4	No Connection
5	Ground
6	No Connection
7	No Connection
8	No Connection
9	No Connection

Table 2.1. RS232 Female DCE Pinout

This port is not intended to be a permanent connection and the cable shall be less than 2m (6.5 ft) in length.

3. Ethernet Ports

3.1. Ethernet over VDSL Port

3.1.1. Overview

The Ethernet over VDSL (EoVDSL) port operates in pairs with one unit configured as the Master and the other as the Slave. In VDSL literature the terms Central Office (CO) or Line Termination (LT) are used interchangeably for the Master and the terms Customer Premise Equipment (CPE) or Network Termination (NT) are used interchangeably for the Slave. The Master unit dictates the line configuration settings to the Slave so all EoVDSL configuration is done on the Master. Data flowing from the Master to the Slave is designated “downstream” while data flowing from the Slave to the Master is designated “upstream”.

RuggedCom offers two flavours of VDSL: Universal EoVDSL and Long-Reach EoVDSL. Universal EoVDSL ports are Master/Slave selectable and offer symmetric data rates up to 35 Mbps with distances up to 2.5 km. Long-Reach EoVDSL ports are fixed as either Master or Slave but offer asymmetric data rates up to 40 Mbps with distances up to 5 km. The Universal and Long-Reach EoVDSL ports are physically indistinguishable from each other; however, you can determine which port you have either from the order code or through the software.

3.1.2. Wiring

VDSL operates over 2-wire Category 3 (CAT-3) or higher twisted-pair wiring. Other twisted-pair wiring with similar characteristics may work although the performance will vary depending on the cable characteristics and distance.

Wiring Tips:

- Twisted-pairs are effective way of reducing both magnetic and capacitive interference because it reduces the magnetic loop area to nearly zero and ensures a consistent distribution of capacitances to both ground and other sources. Therefore, ensure twisting is consistent throughout cable length.
- Open leads (also known as bridged taps or drop-lines) along the length of the cable will cause an impedance mismatch and result in VDSL signal degradation.
- Ensure the cable impedance is consistent throughout the run; Avoid mixing different wiring (for example, wiring with different gauges) in cable runs because this will cause an impedance mismatch and result in VDSL signal degradation.
- Ensure wiring is adequately separated power and control circuits. Switching spikes and surges in power and control circuits can couple noise onto the VDSL line causing interruptions in communications.
- Lower speeds are less susceptible to interference and will transmit greater distances over the same wiring than higher speeds. Use the minimum speed that will provide adequate data transfer speed.

3.1.3. RJ11 Port

EoVDSL data ports allow connection using RJ11 male connectors. The figure below shows the RJ11 port pin-out and LEDs. On units with Universal EoVDSL ports the Master LED can be toggled on or off depending on whether the port is set as a Master or Slave. On units with Long-Reach EoVDSL ports the Master unit will have the LED permanently on while the Slave unit will have the LED permanently off.

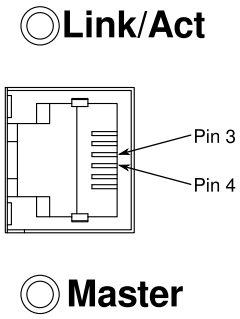

Figure 3.1. RJ11 Port Pinout

Pin	Signal
3	Ring
4	Tip

Table 3.1. RJ11 Port Pinout

Status LED	Colour	Activity	Comments
Master	Green	On	Master Mode
	Off	Slave Mode	
Link / Act	Green	Solid	Link Established
	Blinking	Tx Activity	

Table 3.2. RJ11 Port LEDs

3.1.4. Configuration & Setup

If the units have Universal EoVDSL ports, use the software to configure one unit as a Master and the other as a Slave. If the units have a Long-Reach EoVDSL port, no Master/Slave software configuration is necessary since the ports will already be fixed as Master or Slave. Once configured as Master and Slave and connected together, the units will then attempt to achieve the maximum speed based on the line length and conditions. The unit's link LED may flash on and off several times before settling on a final link speed and declaring the port up. For detailed configuration options please consult the Rugged Operating System (ROS) Software User Guide.

3.1.5. Performance

The EoVDSL ports can be configured in two modes – Auto Mode and Manual Mode. In Auto Mode, which is the default mode, the unit will step through the different speeds and automatically select the best bit-rate based on current line conditions. In Manual Mode the user can select one of the speed settings and the unit will only attempt to attain the set speed. If the line conditions degrade (reducing the SNR) but the unit is able to maintain the link, an alarm will be triggered to notify the user of the reduced SNR. If the line conditions degrade such that the unit is unable to maintain the current link, the unit will restart the scan process if in Auto Mode or re-attempt to attain the set speed if in Manual Mode.

On 24 American Wire Gauge (AWG) Polyethylene Insulated Cable (PIC) twisted-pair the following performance is typical with Universal EoVDSL ports:

Distance [km]	Distance [feet]	Downstream / Upstream [Mbps]	Time to Achieve Port Up in Auto Mode [Seconds]
0.50	1600	35	15
0.60	2000	30	30
0.70	2300	25	45
0.90	3000	20	60
1.00	3300	15	75
1.30	4300	10	90
1.70	5600	5	105
2.00	6600	2.5	120
2.50	8200	1.2	150

Table 3.3. Typical Performance on 24 AWG PIC twisted-pair with Universal EoVDSL ports

The following performance is typical with Long-Reach EoVDSL ports:

Distance [km]	Distance [feet]	Downstream (Master to Slave) [Mbps]	Upstream (Slave to Master) [Mbps]	Time to Achieve Port Up in Auto Mode [Seconds]
0.50	1600	40	20	15
1.00	3300	25	5	30
1.50	4900	20	0.54	45
2.00	6600	15	0.54	60
2.50	8200	10	0.54	75
3.20	10500	5	0.54	90
4.00	13100	2.1	0.54	105
4.60	15100	1.2	0.54	120
5.00	16400	0.48	0.18	150

Table 3.4. Typical Performance on 24 AWG PIC twisted-pair with Long-Reach EoVDSL ports

1. *The EoVDSL ports are designed to be used on private communications lines for point-to-point connections and are not to be connected to the Public Switched Telephone Network (PSTN).*
2. *To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cord.*
3. *In Manual Mode, assuming the distance can support the speed setting; the time to port up is typically 15-30 seconds.*

3.2. Copper Ethernet Port

Units with 10/100Base-TX ports allow connection to standard Category 5 (CAT-5) unshielded twisted-pair (UTP) cable with RJ45 male connectors. The RJ45 receptacles are directly connected to the chassis ground on the unit and can accept CAT-5 shielded twisted-pair (STP) cables. If shielded cables are used, care must be taken to ensure the shielded cables do not form a ground loop via the shield wire and the RJ45 receptacles at either end. The figure below shows the shows the RJ45 port pin-out and LEDs.

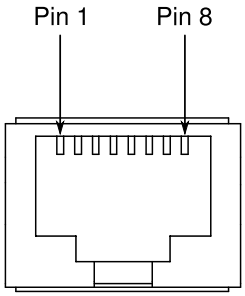

Figure 3.2. RJ45 port Pinout

Pin	Signal
1	+Rx
2	-Rx
3	+Tx
4	No Connection
5	No Connection
6	-Tx
7	No Connection
8	No Connection
Case	Shield (Chassis Ground)

Table 3.5. RJ45 Port Pinout

Status LED	Colour	Activity	Comments
Speed LED	Yellow	Off	10 Mbps
		On	100 Mbps
Link LED	Yellow	Solid	Link Established
		Blinking	Tx/Rx Activity

Table 3.6. RJ45 Port LEDs

3.3. Fiber Optic Ethernet Port

Depending on the order code of the product, the unit can be equipped with several different fiber optic ports. The Transmit (Tx) and Receive (Rx) connections of each port must be properly connected and matched for proper link and operation. The drawings in the following figures show each fiber optical connector style with a side and top view to allow the user to identify the proper cable connection orientation.

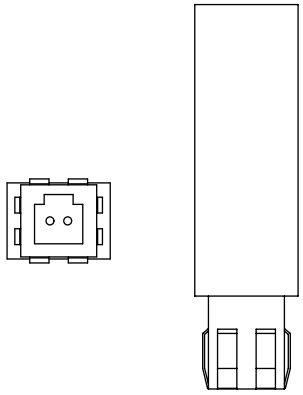

Figure 3.3. 100FX MTRJ Connector

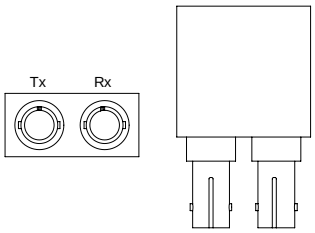

Figure 3.4. 100FX ST Connector

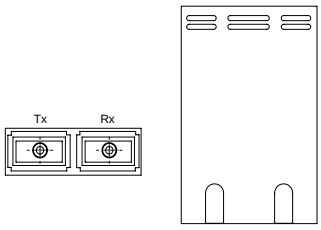

Figure 3.5. 100FX SC Connector

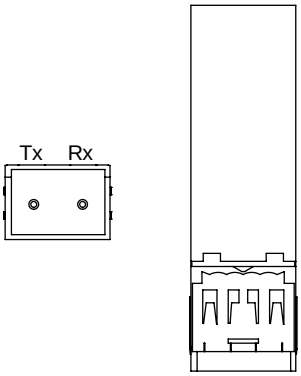

Figure 3.6. 100FX LC Connector

3.4. Wireless Ethernet Port

Refer to the “RuggedCom Wireless Guide” for an introduction to 802.11 Ethernet-based wireless technologies and for answers to frequently asked questions.

Refer to the “Rugged Operating System (ROS) User Guide” for instructions on wireless port configuration.

Both documents can be downloaded from:

- http://www.ruggedcom.com/products/ruggedwireless/rs900w

4. Serial Ports

Serial ports can be either DB9 Serial ports, RJ45 serial ports or Fiber Serial ports

4.1. DB9 Serial Port

The DB9 port is selectable via software to be RS232, RS485 or RS422.

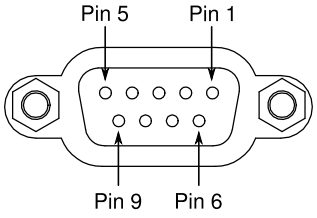

Figure 4.1. DB9 Female DCE Port Pinout

Pin	RS232 Mode	RS485 Mode	RS422 Mode
1	DCD	-	-
2	TX	TX/RX+	TX+
3	RX	-	RX+
4	DTR	-	-
5	Common (Isolated Ground)		
6	DSR	-	RX-
7	CTS	TX/RX -	TX-
8	RTS	-	-
9	RI (No Connection)	-	-
Shield	Chassis Ground		

Table 4.1. DB9 Female DCE Port Pinout

Status LED	State	Activity
Serial Port LED 1, 2	On	Serial TX or RX activity
Serial Port LED 1, 2	Off	No serial TX or RX activity

Table 4.2. DB9 Serial Port LEDs

1. *No internal termination is provided.*
2. *Pins 1, 4, and 6 are connected internally. Pins 7 and 8 are connected internally. In RS232 mode, these pins enter a high impedance state. A DTE that asserts DTR and expects DSR or CD will operate correctly. A DTE that asserts RTS will see CTS asserted, although the RuggedServer will not perform hardware flow control.*
3. *The Common terminals are optically isolated; however, there is transient voltage protection circuitry between the Common terminals and chassis ground.*

4.2. RJ45 Serial Port

The RJ45 Serial port is selectable via software to be RS232, RS485 or RS422.

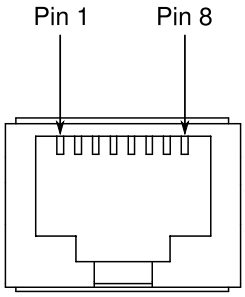

Figure 4.2. RJ45 Port Pinout

Pin	RS232 Mode	RS485 Mode	RS422 Mode
1	DSR	-	RX-
2	DCD	-	-
3	DTR	-	-
4	Common (Isolated Ground)		
5	RX	-	RX+
6	TX	TX/RX +	TX +
7	CTS	-	-
8	RTS	TX/RX -	TX -
Shield	Chassis Ground		

Table 4.3. RJ45 Port Pinout

Status LED	State	Activity
Serial Port LED 1, 2	On	Serial TX or RX activity
Serial Port LED 1, 2	Off	No serial TX or RX activity

Table 4.4. RJ45 Serial Port LEDs

1. *No internal termination is provided.*
2. *Pins 1, 2, and 3 are connected internally. Pins 7 and 8 are connected internally. In RS232 mode, these pins enter a high impedance state. A DTE that asserts DTR and expects DSR or CD will operate correctly. A DTE that asserts RTS will see CTS asserted, although the RuggedServer will not perform hardware flow control.*
3. *The Common terminals are optically isolated; however, there is transient voltage protection circuitry between the Common terminals and chassis ground.*

4.3. Fiber Serial Port

The Fiber Serial Interface (ST connector only) allows RS485, RS422, or RS232 devices to communicate over secure, noise immune, optically isolated, fiber optic cabling at extended distances. It also provides protocol independent conversion to multimode fiber optics.

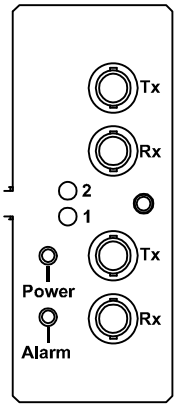

Figure 4.3. Fiber Serial Interface (ST Connector)

Status LED	State	Activity
Serial Port LED 1, 2	On	Serial TX or RX activity
Serial Port LED 1, 2	Off	No serial TX or RX activity

Table 4.5. Fiber Serial Port LEDs

4.4. RS485 Wiring

Each RS485 port can communicate to multiple RS485 devices by daisy chaining devices over a single twisted pair with transmit and receive signals on the same two wires (half duplex). The following guidelines should be followed to ensure reliable continuous communication:

- To minimize the effects of ambient electrical noise, shielded cabling is recommended.
- The correct polarity must be observed throughout a single daisy chain.
- The number of devices wired should not exceed 32, and total distance should be less than 4000 feet (at 100 kbps).
- The Common terminals should be connected to the common wire inside the shield.
- The shield should be connected to earth ground at a single point to avoid loop currents
- The twisted pair should be terminated at each end of the chain.

The figure below shows the recommended RS485 wiring.

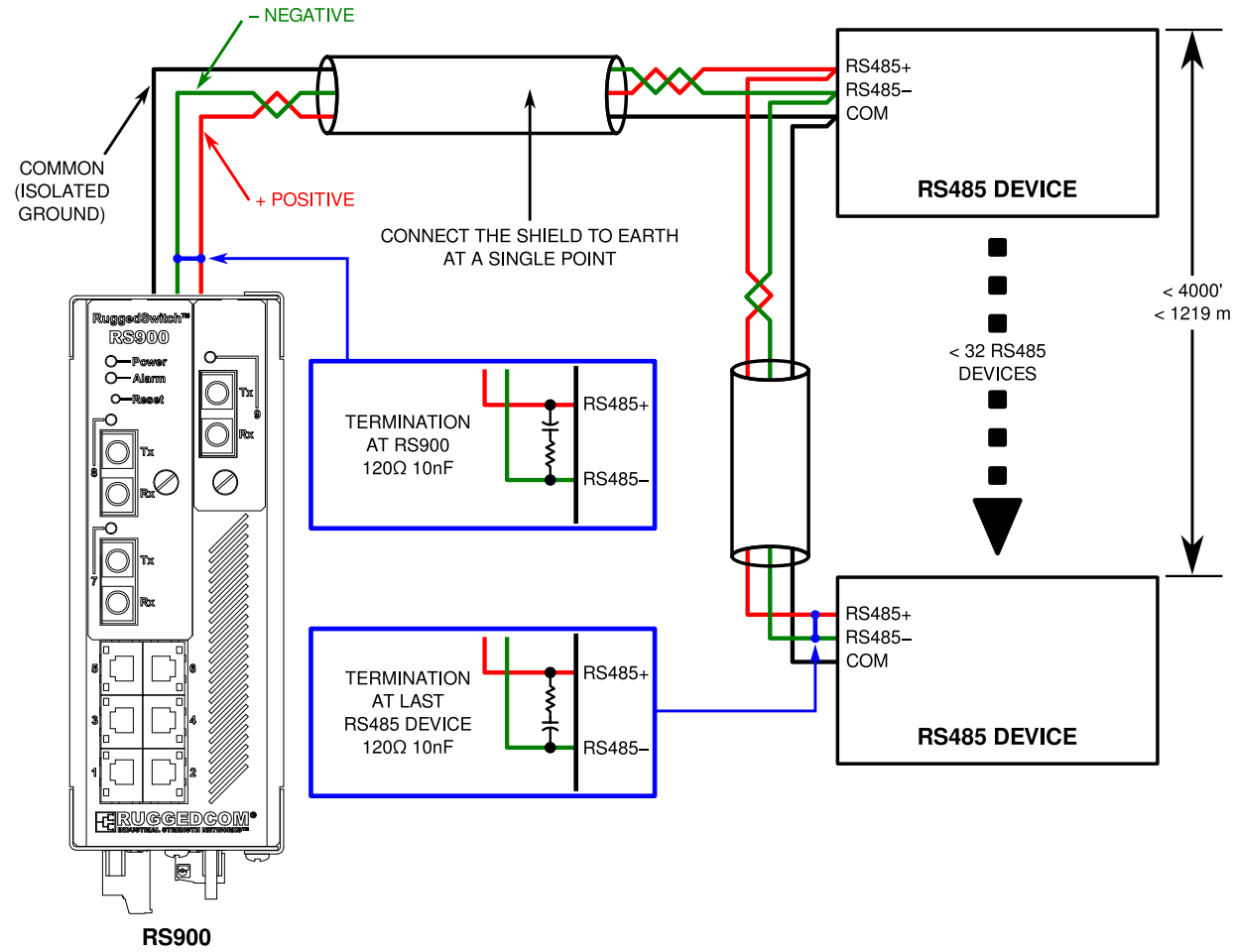

Figure 4.4. Conceptual Recommended RS485 Wiring Diagram

5. Transient Protection

RuggedCom does not recommend the use of copper cabling of any length for critical real-time substation automation applications. However, transient suppression circuitry is present on all copper ports to protect against damage from electrical transients and to ensure IEC 61850-3 and IEEE 1613 Class 1 conformance. This means that during the transient event communications errors or interruptions may occur but recovery is automatic.

RuggedCom also does not recommended to use these ports to interface to field devices across distances which could produce high levels of ground potential rise, (i.e. greater than 2500V) during line to ground fault conditions.

RuggedCom requires the use of external surge protection in VDSL applications where the line may be subject to surges greater than that for which the device is rated. Use the following specifications as a guide for VDSL external surge protection:

- Clamping Voltage: 50V to 200V
- Insertion Loss: < 0.1 dB at 10 MHz
- Peak Surge Current: 10 kA, 8x20µs waveform

6. Technical Specifications

6.1. Operating Environment

Parameter	Range	Comments
Ambient Operating Temperature	-40 to 85°C	Ambient Temperature as measured from a 30 cm radius surrounding the center of the enclosure.
Ambient Storage Temperature	-40 to 85°C	
Ambient Relative Humidity	5% to 95%	Non-condensing

Table 6.1. Operating Environment

6.2. Power Supply Specifications

Power Supply Type	Minimum Input	Maximum Input	Internal Fuse Rating	Isolation	Maximum Power Consumption
12 – 24 VDC	10 VDC	36 VDC	3.15 (T)[a]	1.5 kV DC	10W
24 VDC	18 VDC	36 VDC	3.15 (T)[a]	1.5 kV DC	
48 VDC	36 VDC	72 VDC	3.15 (T)[a]	1.5 kV DC	
HI (125/250 VDC) [b] HI (110/230 VAC) [b]	88 VDC 85 VAC	300 VDC 265 VAC	3.15 (T)[a]	4 kV AC 5.5 kV DC	

[a] (T) denotes time-delay fuse.

[b] This is the same power supply for both AC and DC.

Table 6.2. Power Supply Specifications

6.3. Failsafe Relay Specifications

Parameter	Value
Max Switching Voltage	30VAC, 80VDC
Rated Switching Current	0.3A @ 30VAC 1A @ 30VDC, 0.3A @ 80VDC

Table 6.3. Failsafe Relay Specifications

1. *Resistive Load.*
2. *For Class-2 circuits only.*

Isolation	Comments
1500 Vrms	Dielectric test voltage (1 minute) between coil & contacts

Table 6.4. Failsafe Relay Isolation

6.4. Ethernet Ports Specifications

6.4.1. RJ11 Ethernet over VDSL Port Specifications

Data Port	Media	Distance	Connector Type
EoVDSL	CAT-3 UTP or STP	2500m	RJ11

Table 6.5. RJ11 Ethernet over VDSL Port Specifications

6.4.2. RJ45 Ethernet Port Specifications

Data Port	Media	Distance	Connector Type
10/100 Mbps	CAT-5 UTP or STP	100m	RJ45

Table 6.6. RJ45 Ethernet Port Specifications

6.4.3. Fiber Optic Ethernet Port Specifications

Order Code	Speed Standard	Mode / Connector	Tx (nm)	Cable Type (µm)	Tx min (dBm)	Tx max (dBm)	Rx Sensitivity (dBm)	Rx Saturation (dBm)	Typical Distance (km)	Power Budget (dB)
MJ	100FX	MM/MTRJ	1300	50/125	-22.5	-14	-33.5	-14	2	11
				62.5/125	-19	-14	-33.5	-14	2	14.5
MC	100FX	MM/SC	1300	50/125	-22.5	-14	-33.9	-14	2	11.4
				62.5/125	-19	-14	-33.9	-14	2	14.9
MT	100FX	MM/ST	1300	50/125	-22.5	-14	-33.9	-14	2	11.4
				62.5/125	-19	-14	-33.9	-14	2	14.9
ML	100FX	MM/LC	1310	62.5/125	-19	-14	-32	-14	2	13
T2	100FX	SM/ST	1310	9/125	-15	-7	-34	-3	20	19
L2	100FX	SM/LC	1300	9/125	-15	-8	-38	-3	20	23
C2	100FX	SM/SC	1300	9/125	-15	-8	-31	-7	20	16
L5	100FX	SM/LC	1310	9/125	-5	0	-35	-3	50	30
C5	100FX	SM/SC	1310	9/125	-5	0	-34	-3	50	29
L9	100FX	SM/LC	1310	9/125	0	5	-37	0	90	37
C9	100FX	SM/SC	1310	9/125	5	0	-37	0	90	42

Table 6.7. Fiber Optic Port Specifications

1. *All values listed are average values*
2. *To convert from average to peak add 3 dBm. To convert from peak to average, subtract 3 dBm.*
3. *Maximum segment length is greatly dependent on factors such as fiber quality, and number of patches and splices. Please consult RuggedCom sales associates when determining maximum segment distances.*

6.4.4. Communication Standards

Protocol	Standards
Ethernet	IEEE 802.3
VDSL	ETSI TS 101 270-2 V1.1.1, ITU-T G.993.1, ANSI T1E1.4

Table 6.8. Communication Standard Compliance

6.5. Wireless Ethernet Port Specification

6.5.1. Supported Wireless Standards

Standard	Parameter	Mode	Notes
IEEE 802.11g	54 Mbps (WLAN)	Full Access Point	2.4 GHz ISM
IEEE 802.11b	11 Mbps (WLAN)	Client support	Backwards compatibility
IEEE 802.11i	Strong Encryption	WPA2-AES (CCMP)	Robust Secure Network (RSN)
	Enhanced Encryption	WPA-TKIP (RC4)	Temporal keys
	Basic Encryption	WEP (RC4)	Up to 4 static keys
IEEE 802.1x	Wireless Authentication	'Personal' or 'Enterprise'	PSK or RADIUS

Table 6.9. Supported Wireless Standards

6.5.2. Radio Characteristics

Standard	Parameter
Modulation	Direct Sequence Spread Spectrum 802.11b / OFDM 802.11g
Frequency Range	2.4 Ghz – 2.4965 Ghz
Data Rate	6-54 Mbps: OFDM 11 Mbps: CCK 5.5 Mbps: CCK 2 Mbps: DQPSK 1 Mbps: DBPSK
Channels	11 – US (FCC) 11 - CAN (IC) 14 – Japan (MKK) 13 – Other countries (ETS)
Output Power	100 mW (20dBm) 802.11b 11Mbps Data Rate 100 mW (20dBm) 802.11g 6-24Mbps Data Rate 79 mW (19dBm) 802.11g 36Mbps Data Rate 63 mW (18dBm) 802.11g 48Mbps Data Rate 40 mW (16dBm) 802.11g 54Mbps Data Rate
Receiver Sensitivity	At Radio 802.11b 11Mb@-88dBm / With Antenna: 11Mb@-91dBm At Radio 802.11g 54Mb@-74dBm / With Antenna: 54Mb@-77dBm

Table 6.10. Radio Characteristics

6.5.3. Channel Allocations for IEEE 802.11b/g

The channel identifiers, channel center frequencies, and regulatory domains of each IEEE 802.11b/g 22-MHz-wide channel are shown in the table below.

Channel Identifier	Frequency(MHz)	Regulatory Domains			
		America (-A)	EMEA (-E)	Japan (-J)	Rest of World (-W)
1	2412	X	X	X	X
2	2417	X	X	X	X
3	2422	X	X	X	X
4	2427	X	X	X	X
5	2432	X	X	X	X
6	2437	X	X	X	X
7	2442	X	X	X	X
8	2447	X	X	X	X
9	2452	X	X	X	X
10	2457	X	X	X	X
11	2462	X	X	X	X
12	2467	-	X	X	X
13	2472	-	X	X	X
14	2484	-	-	X	-

Table 6.11. Channel allocations for IEEE 802.11b/g

1. *Mexico is included in the Rest of World regulatory domain; however, channels 1 through 8 are for indoor use only while channels 9 through 11 can be used indoors and outdoors. Users are responsible for ensuring that the channel set configuration complies with the regulatory standards of Mexico.*
2. *In Japan, channel 14 is not supported for 802.11g mode.*

6.6. Serial Ports Specifications

6.6.1. DB9 & RJ45 Serial Port Specifications

Parameter	Specifications	Notes
Baud Rate	300 bps – 230 kbps	
Connector	DB9 or RJ45	
Isolation	2.5 kV	RMS 1-minute

Table 6.12. Copper Port Specification

6.6.2. Fiber Serial Port Specifications

Parameter	Specifications
Mode	Multimode
Connector	ST
Typical Dist. (km)	5
Optical Wavelength (nm)	820
Cable Size Core/Cladding (um)	50/125 62.5/125

Table 6.13. Fiber Optic Port Specification

6.7. Mechanical Specifications

Parameter	Value
Dimensions	16.8 × 11.7 × 6.6 cm / 6.6 × 4.6 × 2.6 inches
Weight	1.2 kg / 2.7 lbs
Enclosure	20 AWG Galvanized Steel

Table 6.14. Mechanical Specifications

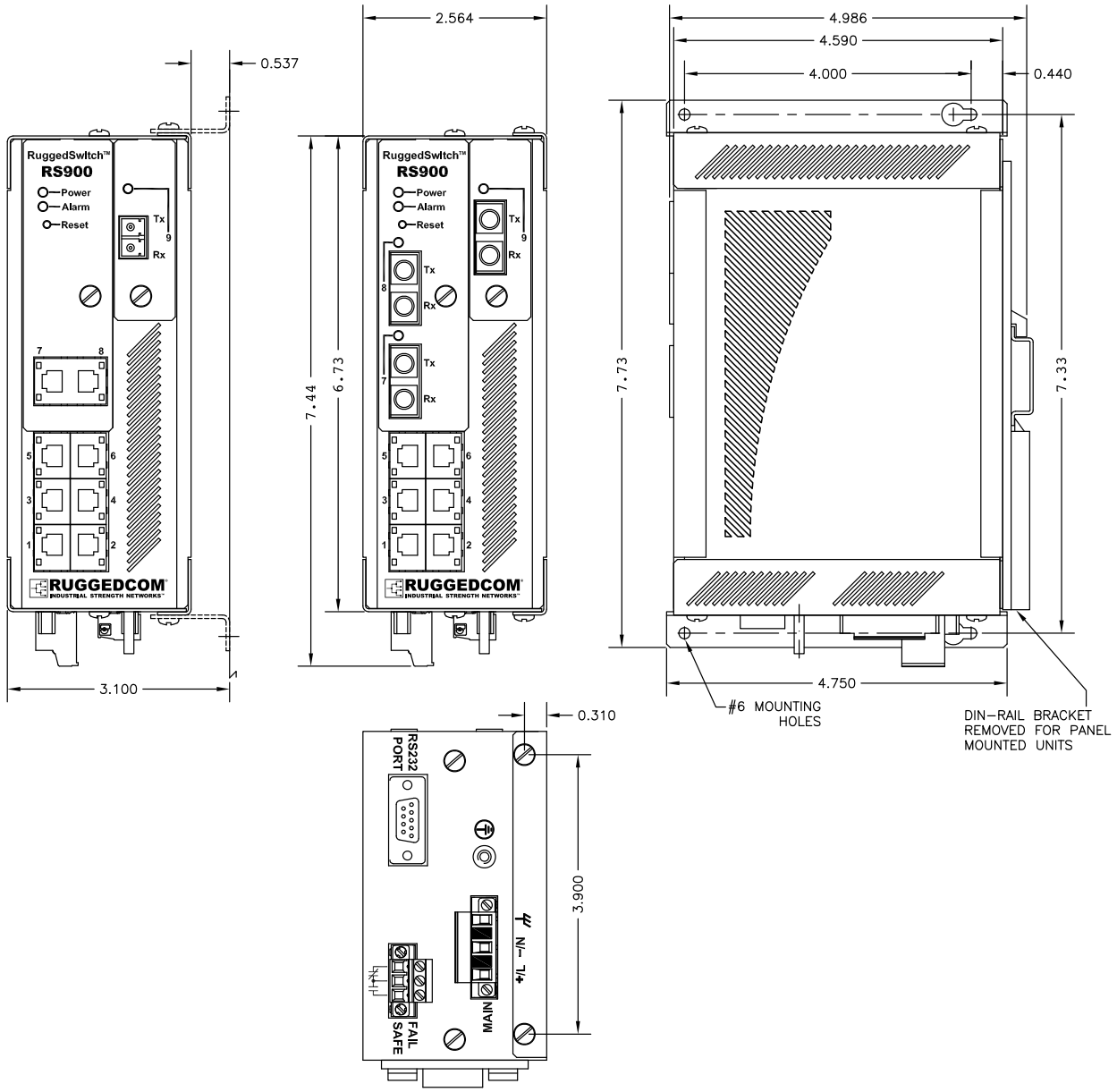

Figure 6.1. Mechanical Specifications

7. Type Tests

7.1. IEC 61850-3 Type Tests

Test	Description		Test Levels	Severity Levels
IEC 61000-4-2	ESD	Enclosure Contact	+/- 8kV	4
		Enclosure Air	+/- 15kV	4
IEC 61000-4-3	Radiated RFI	Enclosure ports	20 V/m	x
IEC 61000-4-4	Burst (Fast Transient)	Signal ports	+/- 4kV @ 2.5kHz	x
		D.C. Power ports	+/- 4kV	4
		A.C. Power ports	+/- 4kV	4
		Earth ground ports	+/- 4kV	4
IEC 61000-4-5	Surge	Signal ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
		D.C. Power ports	+/- 2kV line-to-earth, +/- 1kV line-to-line	3
		A.C. Power ports	+/- 4kV line-to-earth, +/- 2kV line-to-line	4
IEC 61000-4-6	Induced (Conducted) RFI	Signal ports	10V	3
		D.C Power ports	10V	3
		A.C. Power ports	10V	3
		Earth ground ports	10V	3
IEC 61000-4-8	Magnetic Field	Enclosure ports	40 A/m continuous, 1000 A/m for 1 s	N/A
IEC 61000-4-29	Voltage Dips & Interrupts	D.C. Power ports	30% for 0.1s, 60% for 0.1s, 100% for 0.05s	N/A
		A.C. Power ports	30% for 1 period, 60% for 50 periods	N/A
IEC 61000-4-11			100% for 5 periods, 100% for 50 periods 2	N/A
IEC 61000-4-12	Damped Oscillatory	Signal ports	2.5kV common, 1kV differential mode @ 1MHz	3
		D.C. Power ports	2.5kV common, 1kV differential mode @ 1MHz	3
		A.C. Power ports	2.5kV common, 1kV differential mode @ 1MHz	3
IEC 61000-4-16	Mains Frequency Voltage	Signal ports	30V Continuous, 300V for 1s	4
		D.C. Power ports	30V Continuous, 300V for 1s	4
IEC 61000-4-17	Ripple on D.C. Power Supply	D.C. Power ports	10%	3
IEC 60255-5	Dielectric Strength	Signal ports	2kV AC (Fail-Safe Relay output)	N/A
		D.C. Power ports	1.5kV DC	N/A
		A.C. Power ports	2kV DC	N/A
IEC 60255-5	H.V. Impulse	Signal ports	5kV (Fail-Safe Relay output)	N/A
		D.C. Power ports	5kV	N/A
		A.C. Power ports	5kV	N/A

Table 7.1. IEC 61850-3 Type Tests

7.2. IEEE 1613 Type Tests

IEEE Test	IEEE 1613 Clause	Description		Test Levels
C37.90.3	9	ESD	Enclosure Contact	+/- 8kV
			Enclosure Air	+/- 15kV
C37.90.2	8	Radiated RFI	Enclosure ports	35 V/m
C37.90.1	7	Fast Transient	Signal ports	+/- 4kV @ 2.5kHz
			D.C. Power ports	+/- 4kV
			A.C. Power ports	+/- 4kV
			Earth ground ports	+/- 4kV
C37.90.1	7	Oscillatory	Signal ports	2.5kV common mode @ 1MHz
			D.C. Power ports	2.5kV common & differential mode @ 1MHz
			A.C. Power ports	2.5kV common & differential mode @ 1MHz
C37.90	6	H.V. Impulse	Signal ports	5 kV (Failsafe Relay)
			D.C. Power ports	5 kV
			A.C. Power ports	5 kV
C37.90	6	Dielectric Strength	Signal ports	2kV AC(Failsafe Relay)
			D.C. Power ports	1.5kV DC
			A.C. Power ports	2kV AC

Table 7.2. IEEE 1613 Type Tests

1. *If the unit contains copper ports the IEEE 1613 conformance is Class 1 (During disturbance errors may occur but recovery is automatic).*
2. *If the unit contains all fiber ports the IEEE 1613 conformance is Class 2 (During disturbance no errors will occur).*

7.3. IEC Environmental Type Tests

Test	Description		Test Levels	Severity Levels
IEC 60068-2-1	Cold Temperature	Test Ad	-40 deg. C, 16 Hours	N/A
IEC 60068-2-2	Dry Heat	Test Bd	+85 deg. C, 16 Hours	N/A
IEC 60068-2-30	Humidity (Damp Heat, Cyclic)	Test Db	95% (non-condensing), 55°C, 6 cycles	N/A
IEC 60255-21-1	Vibration		2g @ (10-150) Hz	Class 2
IEC 60255-21-2	Shock		30g @ 11 ms	Class 2

Table 7.3. Environmental Type Tests

8. Agency Approvals

Agency	Standards	Comments
CSA	CSA C22.2 No. 60950, UL 60950	Approved
CE	EN 60950, EN 61000-6-2	CE Compliance is claimed via Declaration of Self Conformity Route
FCC	FCC Part 15, Class A	Approved
CISPR	EN55022, Class A	Approved
FDA/CDRH	21 CFR Chapter 1, Subchapter J	Approved
IEC/EN	EN60825-1:1994 + A11:1996 + A2:2001	Approved
CSA	Hazardous Locations Class 1, Division 2, Groups A, B, C, & D. T6 rating at 40°C, T4A rating at 85°C	Approved

Table 8.1. Agency Approvals

Appendix A. Warranty

RuggedCom warrants this product for a period of five (5) years from the date of purchase. This product contains no user-serviceable parts. Attempted service by unauthorized personnel shall render all warranties null and void. For warranty details, visit www.RuggedCom.com or contact your customer service representative.

Should this product require service, contact the factory at:

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